WHAT IS CLAIMED IS:

1. An image coding/decoding method in which an image coding apparatus sends coded information which is obtained by coding an original image to an image decoding apparatus and said image decoding apparatus decodes said coded information to obtain a reproduced image, said image coding apparatus performing the steps of:

extracting edge information which represents an edge part of said original image;

obtaining density information of an edge smoothed image from said original image by smoothing said edge part;

obtaining coded edge information by coding said edge information according to a first coding algorithm;

obtaining coded density information by coding said density information of said edge smoothed image according to a second coding algorithm;

sending said coded edge information and said coded density information as said coded information to said image decoding apparatus; and

said image decoding apparatus performing the steps of:

obtaining said edge information by decoding said coded edge information according to a first decoding algorithm corresponding to said first coding algorithm;

obtaining said density information of said edge smoothed image by decoding said coded density information according to a second decoding algorithm corresponding to said second coding algorithm;

obtaining said reproduced image from said density information of said edge smoothed image by sharpening said edge part of said edge smoothed

image by using said edge information.

2. The image coding/decoding method as claimed in claim 1, said image coding apparatus smoothing said edge part by performing, while scanning said original image pixel by pixel, the steps of:

performing first matrix operation by using a first block density information vector and a smoothing matrix, wherein said first block density information vector is obtained by arranging density information of each pixel included in a first block, said first block includes a pixel in said edge part or in a near region of said edge part and includes pixels in a surrounding region around said pixel, and order of said first block density information vector corresponds to the number of pixels in said first block, and wherein said smoothing matrix includes coefficients used for edge smoothing which operate on density information of each pixel in said first block;

obtaining smoothed density information of each pixel by overlaying density information of each pixel in said first block obtained by performing said first matrix operation on each pixel while scanning said original image pixel by pixel.

3. The image coding/decoding method as claimed in claim 2, said image decoding apparatus sharpening said edge part of said edge smoothed image by performing, while scanning said edge

smoothed image pixel by pixel, the steps of:

performing second matrix operation by using a second block density information vector and a sharpening matrix which is an inverse matrix of said smoothing matrix, wherein said second block density information vector is obtained by arranging density information of each pixel included in a second block, said second block includes a pixel in said edge part or in a near region of said edge part and pixels in said surrounding region, and order of said second block density information vector corresponds to the number of pixels in said second block; and

obtaining sharpened density information of each pixel by overlaying density information of each pixel in said second block obtained by performing said second matrix operation on each pixel while scanning said edge smoothed image pixel by pixel.

4. The image coding/decoding method as claimed in claim 1, said image coding apparatus smoothing said edge part by performing the steps of:

obtaining density information x' of a pixel of said edge part of said edge smoothed image according to a first equation $x'=(1-\lambda)x+\lambda C$, wherein λ is a positive constant, x is density information of said pixel of said original image, and C is surrounding density information representing density state of a surrounding region of said pixel.

5. The image coding/decoding method as

claimed in claim 4, said image decoding apparatus sharpening said edge part of said edge smoothed image by using a predetermined equation according to a steepest-descent method, said predetermined equation being defined on the basis of the relationship between said density information x' and sharpened density information formulated by said first equation.

6. The image coding/decoding method as claimed in claim 5, wherein said predetermined equation is $e(X)=\left(X+\frac{1}{1-\lambda}(\lambda C(n)-x')\right)^2$ in which C(n) is said surrounding density information for a pixel having density information x' and n is a repetition count number, and a value of X which minimizes e(X) is obtained by said steepest-descent method and said value of X becomes density information of a pixel after sharpened.

7. The image coding/decoding method as claimed in claim 6, wherein, in a process according to said steepest-descent method, X is obtained as a convergence value of a recurrence formula $X(n+1)=X(n)-G*\frac{\partial e}{\partial X}$, wherein G is a constant.

8. An image coding apparatus comprising:

an edge extracting part for extracting edge information which represents an edge part of an original image;

an edge smoothing part for obtaining density information of an edge smoothed image from said original image by smoothing said edge part;

a first coding part for obtaining coded edge information by coding said edge information according to a first coding algorithm;

a second coding part for obtaining coded density information by coding said density information of said edge smoothed image according to a second coding algorithm;

wherein said coded edge information and said coded density information are coded information of said original image.

9. The image coding apparatus as claimed in claim 8, said edge smoothing part including a density information correction part for correcting density information of each pixel such that variation of density levels represented by density information of pixels which are arranged across said edge part in a near region of said edge part of said original image is lowered.

10. The image coding apparatus as claimed in claim 9, said density information correction part comprising:

a mean value calculation part for

calculating a mean value of said density levels in a predetermined region; and

a density level judgement part for judging whether said density level of a pixel is higher or lower than said mean value for each pixel in said near region;

wherein density information is corrected for a pixel in which said density level is higher than said mean value such that said density level is lowered, and density information is corrected for a pixel in which said density level is lower than said mean value such that said density level is increased.

11. The image coding apparatus as claimed in claim 10, wherein said density information correction part corrects density information of each pixel in said near region such that said mean value of said density levels does not change.

12. The image coding apparatus as claimed in claim 8, said edge smoothing part comprising:

a smoothing matrix generation part for generating, for each block which includes said edge part or a near region of said edge part, a smoothing matrix which is used for matrix operation with a block density information vector, wherein said block density information vector is obtained by arranging density information of each pixel included in a block, and order of said block density information vector corresponds to the number of pixels in said block, and wherein said smoothing matrix includes

coefficients used for edge smoothing which operate on density information of each pixel in said edge part or in said near region in said block; and

a matrix operation part for obtaining smoothed density information of each pixel in said block by performing matrix operation by using said smoothing matrix and said block density information vector.

13. The image coding apparatus as claimed in claim 8, said edge smoothing part comprising:

a pixel judgement part for judging whether a pixel exists in said edge part or in a near region of said edge part while scanning said original image pixel by pixel;

a matrix operation part for performing, when said pixel exists in said edge part or in said near region, matrix operation by using a block density information vector and a smoothing matrix, wherein said block density information vector is obtained by arranging density information of each pixel included in a block, said block includes said pixel and pixels in a surrounding region around said pixel, and order of said block density information vector corresponds to the number of pixels in said block, and wherein said smoothing matrix includes coefficients used for edge smoothing which operate on density information of each pixel in said block;

an operation part for obtaining smoothed density information of each pixel by overlaying density information of each pixel in said block obtained by performing said matrix operation on each pixel while scanning said original image pixel by pixel.

14. The image coding apparatus as claimed in claim 13, said pixel judgement part comprising:

a distance conversion part for generating distance information representing distances between said edge part and each pixel; and

a distance judgment part for judging whether said distance information for each pixel is equal to or smaller than a predetermined value;

wherein, when said distance information is judged to be equal to or smaller than said predetermined value, it is judged that a pixel corresponding to said distance information exists in said edge part or in said near region.

15. The image coding apparatus as claimed in claim 8, wherein said edge smoothing part obtains density information x' of a pixel of said edge part of said edge smoothed image according to an equation $x'=(1-\lambda)x+\lambda C$, wherein λ is a positive constant, x is density information of said pixel of said edge part of said original image, and C is surrounding density information representing density state of a surrounding region of said pixel.

16. An image decoding apparatus which decodes coded information which includes coded edge information representing an edge part of an original

image and coded density information representing an edge smoothed image, said image decoding apparatus comprising:

a first decoding part for obtaining edge information representing said edge part by decoding said coded edge information according to a first decoding algorithm;

a second decoding part for obtaining density information of said edge smoothed image by decoding said coded density information according to a second decoding algorithm;

an edge sharpening part for sharpening said edge part of said edge smoothed image by using said edge information such that a reproduced image is obtained.

17. The image decoding apparatus as claimed in claim 16, said edge sharpening part including a density information correction part for correcting density information of each pixel of said edge smoothed image such that variation of density levels represented by density information of pixels which are arranged across said edge part in a near region of said edge part of said edge smoothed image is increased.

18. The image decoding apparatus as claimed in claim 17, said density information correction part comprising:

a mean value calculation part for calculating a mean value of said density levels in a

predetermined region; and

a density level judgement part for judging whether said density level of a pixel is higher or lower than said mean value for each pixel in said near region;

wherein density information is corrected for a pixel in which said density level is higher than said mean value such that said density level is increased, and density information is corrected for a pixel in which said density level is lower than said mean value such that said density level is lowered.

19. The image decoding apparatus as claimed in claim 18, wherein said density information correction part corrects density information of each pixel in said near region such that said mean value of said density levels does not change.

20. The image decoding apparatus as claimed in claim 16, said edge sharpening part comprising:

a sharpening matrix generation part for generating, for each block said edge part or a near region of said edge part in said edge smoothed image, a sharpening matrix which is used for matrix operation with a block density information vector, wherein said block density information vector is obtained by arranging density information of each pixel included in a block, and order of said block

density information vector corresponds to the number of pixels in said block, and wherein said sharpening matrix includes coefficients used for edge sharpening which operate on density information of each pixel in said edge part or in a near region of said edge part in said block; and

a matrix operation part for obtaining sharpened density information of each pixel in said block by performing said matrix operation by using said sharpening matrix and said block density information vector.

21. The image decoding apparatus as claimed in claim 20, wherein said sharpening matrix generation part generates an inverse matrix of a smoothing matrix as said sharpening matrix in which said smoothing matrix is used for obtaining density information of said edge smoothed image which is decoded from said coded density information.

22. The image decoding apparatus as claimed in claim 16, said edge sharpening part comprising:

a pixel judgement part for judging whether a pixel exists in said edge part represented by said edge information or in a near region of said edge part while scanning said edge smoothed image pixel by pixel;

a matrix operation part for performing, when said pixel exists in said edge part or in said near region, matrix operation by using a block

density information vector and a sharpening matrix, wherein said block density information vector is obtained by arranging density information of each pixel included in a block, said block includes said pixel and pixels in a surrounding region around said pixel, and order of said block density information vector corresponds to the number of pixels in said block, and wherein said sharpening matrix includes coefficients used for edge sharpening which operate on density information of each pixel in said block;

an operation part for obtaining sharpened density information of each pixel by overlaying density information of each pixel in said block obtained by performing said matrix operation on each pixel while scanning said edge smoothed image pixel by pixel.

23. The image decoding apparatus as claimed in claim 22, said pixel judgement part comprising:

a distance conversion part for generating distance information representing distances between said edge part and each pixel; and

a distance judgment part for judging whether said distance information for each pixel is equal to or smaller than a predetermined value;

wherein, when said distance information is judged to be equal to or smaller than said predetermined value, it is judged that a pixel corresponding to said distance information exists in said edge part or in said near region said edge smoothed image.

24. The image decoding apparatus as claimed in claim 22, wherein said sharpening matrix is an inverse matrix of a smoothing matrix in which said smoothing matrix is used for obtaining density information of said edge smoothed image which is decoded from said coded density information.

25. The image decoding apparatus as claimed in claim 16, wherein said edge sharpening part sharpens said edge part of said edge smoothed image by using a predetermined equation according to a steepest-descent method, said predetermined equation being defined on the basis of the relationship between density information x' of a pixel of said edge part of said edge smoothed image and sharpened density information formulated by a first equation $x'=(1-\lambda)x+\lambda C$, wherein λ is a positive constant, x is density information of said pixel of said original image, and C is surrounding density information representing density state of a surrounding region of said pixel.

26. The image decoding apparatus as claimed in claim 25, wherein said predetermined equation is $e(X)=\left(X+\frac{1}{1-\lambda}(\lambda C(n)-x')\right)^2$ in which C(n) is said surrounding density information for a pixel having density information x' and n is a repetition

count number, and a value of X which minimizes e(X) is obtained by said steepest-descent method and said value of X becomes density information of a pixel after sharpened.

27. The image decoding apparatus as claimed in claim 26, wherein, in a process according to said steepest-descent method, X is obtained as a convergence value of a recurrence formula $X(n+1)=X(n)-G*\frac{\partial e}{\partial X}$, wherein G is a constant.

28. An image decoding apparatus which decodes coded information of an image, said image decoding apparatus comprising:

an edge information obtaining part for obtaining edge information representing an edge part of said image;

a decoding part for obtaining density information of said image by decoding said coded information according to a predetermined decoding algorithm;

an edge sharpening part for sharpening said edge part represented by said edge information for said density information of said image such that a reproduced image is obtained.

29. The image decoding apparatus as

claimed in claim 28, said edge information obtaining part comprising an edge decoding part for obtaining said edge information by decoding coded edge information which is provided to said image decoding apparatus according to a predetermined decoding algorithm.